DOCUMENT RESUME

ED 065 715 VT 016 193

AUTHOR	Anderson, Ronald D.; And Others
TITLE	An Analysis and Interpretation of Tasks and Competencies Required of Personnel Conducting Exemplary Research and Research-Related Activities in Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
PUB DATE	Aug 71
GRANT	OEG-0-71-0617(520)
NOTE	68p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Ability Identification; Diffusion; *Educational Development; Educational Research; *Educational Researchers; Evaluation; Evaluation Methods; Factor Analysis; Interviews; *Task Analysis
IDENTIFIERS	*Competency Factors

ABSTRACT

There is a void in existing knowledge concerning specific tasks performed by researchers, developers, diffusers, and evaluators and the specific competencies required of them in performing educational research and research-related tasks. The work reported in this document is the analysis and interpretation of data obtained in interviews as outlined in a University task force technical paper. Specific objectives were to identify and delineate, in part empirically: (1) functions (roles) that are required of research and research-related personnel, (2) specific tasks that are required in the performance of each function identified, and (3) competencies (skills and knowledge) necessary to perform each task identified. Factor analysis was used to isolate 12 task factors, factor analysis and additional empirical-logical procedures were used to identify seven competency factors, and relationships between task factors and competency factors were identified. (GEB)

ED 065715

FILMED FROM BEST AVAILABLE COPY

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

No. 23

AN ANALYSIS AND INTERPRETATION OF TASKS AND COMPETENCIES REQUIRED OF PERSONNEL CONDUCTING EXEMPLARY RESEARCH AND RESEARCH-RELATED ACTIVITIES IN EDUCATION

Ronald D. Anderson
John M. Soptick
W. Todd Rogers
Blaine R. Worthen
University of Colorado

August 1971

This paper is produced under support of U. S. Office of Education Grant OEG-0-71-0617(520)

VT016193

AN ANALYSIS AND INTERPRETATION OF TASKS AND COMPETENCIES REQUIRED OF PERSONNEL CONDUCTING EXEMPLARY RESEARCH AND RESEARCH-RELATED ACTIVITIES IN EDUCATION

A void in existing knowledge concerning the training of educational research and research-related personnel is a lack of information on the specific tasks performed by researchers, developers, diffusers, and evaluators and the specific competencies required of them in performing these tasks. The work reported herein is a continuation of previous Task Force efforts to add to existing knowledge in this area. An earlier report of the Task Force (see Technical Paper No. 18) was devoted to a description of an interview procedure for ascertaining tasks and competencies required of personnel engaged in exemplary educational research and research-related work. The work reported herein is the analysis and interpretation of the data obtained in those interviews. The remainder of this paper is organized into sections on the following topics: (1) objectives of the research activities, (2) sources of data employed, (3) compilation and categorization of the data, (4) data analysis procedures, (5) results of the data analysis, and (6) relationships between RDDE and inquiry and inquiry-related functions identified through the data.

Objectives

Since a full description of the background and objectives of the study reported herein are included in Technical Paper No. 18, only a brief summary of the objectives will be included here. Potential uses of the data also are discussed more fully in Technical Paper No. 18. The stated objectives for this research activity are as follows:

1.2 To identify and delineate, in part empirically, the functions (roles) that are required of research and research-related personnel ...

1.3 To identify and delineate, in part empirically, the specific tasks that are required in the performance of each function identified ... (in Objective 1.2)

1.4 To identify and delineate, in part empirically, the competencies (skills and knowledge) necessary to perform each task identified in Objective 1.3.

Source of Data

The data upon which this study is based were acquired through a series of interviews with 116 persons identified as being engaged in exemplary educational research, development, diffusion or evaluation activities. A full description of (1) the procedure used for selecting interviewees, (2) definition of terms, and (3) the interview procedure used to collect data is included in Technical Paper No. 18. Since some readers may not have access to that paper, a brief description of the interview procedure is included here to aid in interpreting the results reported in this paper.

The persons sampled were selected within research organizations that have a broad scope and focus on one or more of the functional areas considered -- research, development, diffusion, and evaluation. Personnel at several levels were interviewed to obtain data about the actual tasks performed and competencies required in their (the interviewees') day-to-day job performance. Tasks (specific activities which are part of the conduct

of research and research-related work, e.g., defining a research problem or preparing a script for a film) were viewed as collections of competencies (skills and knowledge necessary to complete a task, e.g., the ability to construct a good test item).

With the exception of thirteen researchers who were interviewed by telephone, the interviews were conducted personally by one of six trained interviewers at the site at which the interviewee was employed. The interview was designed to yield a list of tasks and competencies that the interviewee thought he employed in performing his work successfully. The interview procedure included both audio-taping the interview and using a form to keep a written record of interviewee responses. These procedures were used to facilitate the interview as well as provide the data sought in the study. Within 24 hours after the interview, the interviewer listened to the audio-tape of the interview to check the accuracy of his written record and make additions, deletions, and modifications as necessary. All audio-tapes and interviewee forms were retained for later compilation and analysis work.

Compilation and Categorization of the Data

Tasks. Prior to any analysis of the data acquired in the interviews, a system of classifying and compiling the data had to be developed and employed. The categories of research, development, diffusion, and evaluation (RDDE) are commonly employed to describe the activities of educational research and research-related personnel but there has been no empirical verification of the apparent logic and appropriateness of these categories for describing such activities. Rather than impose the RDDE rubric on the

data collection process and collecting task and competency data within such a framework, the task and competency data were collected independently of any such set of categories. The intent then was to analyze task data to determine what groupings of tasks (i.e., functions) actually exist. The initial step in this analysis was the logical formulation of a set of 69 categories into which the entire collection of tasks from the 116 interviews could be classified. This set of categories was developed jointly by the six persons who previously had conducted the interviews. A list of the task categories and a description of each are presented in Appendix A.

After task categories were formulated, the interviewers coded each of the tasks identified in their own interviews according to the set of 69 task categories. For purposes of training in categorizing the data, twelve tape-recorded interviews were listened to and coded by the six interviewers (two interviews per interviewer). Then one tape, encompassing the broadest range and greatest number of tasks, was selected for conducting a reliability check. The six interviewers independently (1) listened to the taped interview and recorded the data on forms, and (2) coded the data according to the 69 task categories. Using analysis of variance[1], the average inter-judge reliability was computed on the classified tasks. The average inter-judge reliability was found to be .71. The results of this analysis are reported in Table I.

---

[1]Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962, pp. 124-128.

TABLE I

Analysis of Variance: Inter-rater Reliability for Tasks

SOURCE	df	ms
Between Tasks	68	.56
Within Tasks	345	.16
Between Judges	5	.38
Residual	340	.15

$$r_6 = 1 - \frac{.16}{.56} = .71$$

Competencies. The compilation and categorization of the competency data were conducted in a manner similar to that described above for the task data with the exception that the coding of the data was done by one person. On the basis of the data from thirty interviews, four members of the project staff (two interviewers, the project director, and the data analyst) formulated a preliminary set of categories to use in classifying the competencies. To facilitate the categorization of competencies, twelve general categories were first formed. The specific competencies identified from the thirty interviews were then listed within the appropriate general category to which they belonged. The competencies for the remaining 86 interviews then were categorized by the coder, this person being one who had participated in the formulation of the preliminary set of categories and who, as an interviewer, had conducted the greatest number of interviews. The classification system was expanded slightly as the classification proceeded to allow for the appropriate inclusion of a few additional competencies that had not occurred in the first thirty sets of

data from which the classification system was developed. The final set of 226 competency categories is presented in Appendix B.

A reliability check on the competency data was conducted in the same manner as that described above for the task data. One tape was selected as having the broadest range and greatest number of competencies. Competency data from this tape were recorded on the interview data sheets by the six interviewers. They then classified the data according to an initial form of the competency classification system and the six sets of categorized data were checked for reliability by the same procedure described earlier, resulting in an inter-judge reliability of .68. Results of this analysis are reported in Table II. Although only one interviewer coded the data, the reliability check indicated that recording interview data on the forms was adequately reliable.

TABLE II

Analysis of Variance:
Inter-rater Reliability for Competencies

SOURCE	df	ms
Between Competencies	109	.56
Within Competencies	550	.18
Between Judges	5	.55
Residual	545	.17

$$r_6 = 1 - \frac{.18}{.56} = .68$$

Each interviewee was scored on each of the 69 task categories identified in Appendix A. If the interviewee indicated that he had performed or was performing a given task, he was given a score of one. Otherwise the task score given was zero. These scores were assigned by the person who conducted the interview. The competency data scores were assigned in the same way as for tasks. However, for the competencies, the scores were assigned by the interviewer who was responsible for the categorization of the original competencies. The categorized data for both the tasks and competencies were transferred to computer coding sheets by seven specially trained clerks. A carefully supervised system of double checking the entire scoring procedure was employed to insure its accuracy.

Data Analysis Procedures

The analysis of the data obtained in the interviews was designed to attain the objectives described earlier in this report, i.e., to identify and delineate the functions, tasks, and competencies required of research and research-related personnel. The three terms -- functions, tasks, and competencies -- were defined in Technical Paper No. 18 in this way:

> 'Function' is used herein as a descriptor for a broad range of activities or tasks which taken together lead to the attainment of a particular inquiry goal (e.g., to produce generalizable knowledge about educational phenomena). Examples of function as defined herein are research, development, diffusion and evaluation, although these four functions are not taken as givens for this study; the task analyses may identify tasks which are found to group together in ways that require different function labels.
>
> 'Tasks' are specific activities which are essential in the conduct of each function. Examples of tasks are defining a research problem, writing a final report of an evaluation project, preparing a script for a film, or analyzing data.
>
> 'Competencies' are the specific knowledge and skills used to engage successfully in each task. For example, a data

> analysis task might require (among others) the following competencies: knowledge of analysis of variance, knowledge of computer operations, the ability to select the appropriate statistical technique, the ability to select the appropriate computer program, and the ability to interpret the results of an analysis of variance (pp. 4-5).

To a large extent, the three words, "function," "task" and "competency" express different levels of specificity rather than different basic ideas. A function is fundamentally a collection of tasks, just as a task is comprised of a number of competencies.

As described previously, the interviews provided data on the tasks performed and competencies used by research and research-related personnel; no attempt was made to logically describe the functions these personnel performed. The initial facet of the data analysis was designed to find what "clustering" of tasks actually occurred. This in turn would define functions performed. The analysis involved a factor analysis of the task data.

The next step in the data analysis was to organize the 226 categories of competencies into groupings in terms of their common possession by research and research-related personnel. As with the analysis of the task data, the determination of groupings of competency data was facilitated by factor analytic techniques.

The final major step in the data analysis was to relate the competency factors to the task factors to determine what competencies actually are used in performing each of the task factors (functions) identified through the initial factor analysis. These three stages of the data analysis are described in greater detail below.

Factor Analysis of Task Data

The 69 tasks listed in Appendix A were factor analyzed to ascertain possible groupings and in this way acquire a more precise description of the functions -- collections of tasks -- performed by research and research-related personnel. The input variables consisted of 69 dichotomously scored variables on 116 subjects. Factor extraction was accomplished by a principal axis procedure; squared multiple correlations were used as estimates of the communalities.[2] An oblique transformation was performed using the Harris-Kaiser Independent Clusters solution. The factors to be transformed were selected using the Scree Test.[3] In addition to performing the factor analysis, simple frequencies for each task were obtained.[4]

The matrix of phi correlation coefficients among the 69 tasks is presented in Table C1 of Appendix C. The principal-axis factor extraction produced 48 factors (corresponding to the positive eigenvalues of the intercorrelation matrix of variables with squared multiple correlation coefficients along the diagonal) which accounted for 73.8 percent of the total variance. The results of the Scree Test (presented in Figure D1 of Appendix D) revealed that 12 factors, accounting for 45.4 percent of the

---

[2]The Biomedical computer program BMD03M, General Factor Analysis, was used for this computation. Dixon, W. J. (Ed.) BMD biomedical computer programs. Berkeley and Los Angeles: University of California Press, 1968.

[3]Cattell, R. B. (Ed.) Handbook of multivariate experimental psychology. Chicago: Rand McNally and Company, 1966, p. 241.

[4]The Biomedical computer program BMD04D, Alphanumeric Frequency Count, was used. Dixon W. J. (Ed.) BMD biomedical computer programs. Berkeley and Los Angeles: University of California Press, 1968.

total variance, should be retained for factor transformation. The results of the oblique transformation are presented in the next major section of this report, which includes the results of the data analysis.

Factor Analysis of Competency Data

The 226 competencies identified in the interviews with the 116 subjects were factor analyzed to determine possible competency groupings. Through matching these competency clusters with the task factors identified above it was hoped that it would be possible to identify the competencies (skills and knowledge) necessary in the performance of each general task factor. The analysis of the competencies was conducted across the general task factors obtained from the factor analyses of the tasks. Due to limitations in computer capabilities it was necessary to use a combination of both logical and empirical procedures.

The first step in this process involved the formation of three groups of competencies[5] from the total collection of 226. The intent was to group together in the same group those competencies that logically would be expected to be associated with each other. The three groupings were determined by the four members of the project staff responsible for the categorization of the original competencies. Several of the competencies were placed in more than one grouping. This resulted from the fact that the four members of the project staff felt that some of the competencies logically fit with more than one group. The three groups of competencies,

---

[5]Since the factor analysis program could accommodate a maximum of 85 variables, an upper limit of 85 competencies per package was necessary.

identified as packages 01, 02 and 03 are presented in Tables C2, C3 and C4 of Appendix C.[6]

The first package contains 64 competencies which for the most part are closely related to data analysis and computer operations. The second package contains 80 competencies which relate primarily to evaluation, conceptual and management-administrative competencies. The third package contains 85 competencies related to the development of curriculum materials, conceptual activity, inservice education and management-administration. Several competencies thought to be related to writing skills were included in both the second and third packages.

Each of the three packages was factor analyzed using the same procedure as previously reported for the task data analyses. The results of the factor analyses are reported in Appendix C. Tables C5, C6 and C7 contain the matrices of phi correlation coefficients for the three competency packages. The principal axis extraction (smc's along the diagonal) was used for packages 01, 02 and 03. Application of the Scree Test (presented in Figures D2, D3 and D4 in Appendix D) revealed that 8, 6 and 6 factors (accounting respectively for 42.4, 27.3 and 27.0 percent of the total variance) should be retained for factor transformation. Tables C8, C9 and C10 contain the respective factor pattern matrices, and Tables C11, C12 and C13 contain the correlations among the oblique competency factors for the three packages.

To permit the competencies in the three packages to be factor analyzed in one common analysis (within the computer constraints of 85 variables), the

[6]Thirty-eight competencies for which the frequency of occurrence was less than 6 -- i.e., fewer than 6 of the 116 interviewees listed the competency -- were not included in this analysis.

results of the initial three factor analyses were used to form a fourth package of competencies. The competencies included in the fourth package were selected according to the following criteria:

1. Competencies which had pattern coefficients above .35 in absolute value and which were in at least two of the three initial competency factor patterns were included.

2. Competencies which had pattern coefficients above .48 in absolute value and which were in one of the three initial factor patterns were selected.

3. Competencies were selected so that each of the factors in each of the three factor patterns was represented by at least two of the competencies which loaded on it.

Eighty-two competencies met the criteria above and were selected for inclusion in package 04; these competencies are listed in Table C14 in Appendix C.

A factor analysis of package 04 competencies was accomplished using the same procedures as reported previously for the analysis of the task data. The matrix of phi correlation coefficients among the 82 competencies appears in Table C15 in Appendix C. The principal-axis factor extraction produced 59 factors (corresponding to the positive eigenvalues of the intercorrelation matrix of variables with squared multiple correlation coefficients along the diagonal) which accounted for 80.2 percent of the total variance. The results of the Scree Test (presented in Figure D5 of Appendix D) revealed that seven factors, accounting for 33.5 percent of the total variance, should be retained for factor transformation. Identification and interpretation of the transformed competency factors is given in detail in the next major section of this report.

The processes described above resulted in a reduction from 226 competencies to 82 competencies. (Of the original 226, 38 were excluded

because of low frequencies and 106 failed to meet criteria for forming package 04 above.) Since these reductions were largely caused by limits in computer capacity (e.g., necessity of holding package 04 to fewer than 85 competencies), procedures were employed to use the results of the statistical analysis (e.g., correlation matrices), supported where necessary by logical analyses, to place the 106 high-frequency competencies not previously included in package 04 within the factor pattern obtained for the 82 competencies in that package. The following three criteria were used in this process:

1. Factor analysis results from packages 01, 02 and 03. A competency not included in package 04, but present in package 01, 02 and/or 03, was placed with those competencies with which it loaded in the first three packages. For example, competency C301 was not included in package 04 but was included in package 01. In package 01 it loaded on the same factor and in the same direction as competencies C801, C807, C815 and C826. These latter four competencies were included in package 04, loading together on general competency factor 1. Therefore, C301 was placed, albeit post hoc, on factor 1.

2. First-order correlations. Some of the competencies not included in package 04, but included in packages 01, 02 or 03, did not possess large pattern coefficients (greater than .35 in absolute value) within the factor patterns for packages 01, 02 and 03. However, examination of their first-order correlations revealed that many of these competencies correlated meaningfully with other competencies included in package 04 and cut across several of the factors in the appropriate factor pattern in package 01, 02 and 03. In these cases, the competency was included in more than one

factor of package 04. For example, C212, originally included in package 01, was placed in general competency factors 1 and 2 of the factor pattern for package 04 because of its correlations with other competencies within these two factors.

3. Logical analysis. Thirteen of the original 226 competencies which met neither of the above criteria were placed on one of the seven factors using logical analysis. The four persons responsible for the analyses, working independently, placed each of these competencies on one or more of the seven general competency factors which resulted from package 04. Any disagreements were resolved at a meeting of the four persons, and final placement of these competencies reflected unanimous agreement of the four judges.

Results of this analysis are reported in the next major section of this report.

Relating General Competency Factors to General Task Factors

The third and final stage of the data analysis was the placement of general competency factors with the appropriate general task factors in order to identify those competencies necessary in the performance of each general task factor. This fit between task and competency factors was done on the basis of (1) the frequency of occurrence of the competencies in the performance of each task factor and (2) the results of the factor analyses. A frequency count of the occurrence of each competency in the performance of each task factor was performed. This provided a matrix (226 competencies by 12 task factors) in which one tally was entered for each person who employed a given competency in the performance of a given

task factor. From these data the main relationships between competency factors and task factors were ascertained by the two-stage procedure described below.

Stage one. For each task factor, the most frequently occurring competencies were identified.[7] Of these "high-frequency" competencies, those which were contained in one of the competency factors (from the package 04 factor analysis) were then identified and the number of different high-frequency competencies present from each competency factor was identified. Those competency factors having the largest number of high-frequency competencies were judged to be the competency factors most frequently employed in the performance of the given task factor.

The number of competency factors identified with each task factor varied from one to three, the criteria for inclusion being the presence of three[8] or more of the competencies from the given competency factor in the group of high-frequency competencies under the task factor.

Stage two. Because the above process tended to favor those competency factors which contain a large number of high-frequency competencies at the expense of competencies which occur less frequently but

---

[7]This number ranged across categories, from 10 competencies to 25 competencies; in all but one case, the number of competencies was between 18 and 25. In the case of one task factor, for which the competency frequencies were very low, their number was reduced to 10 to avoid inclusion of a large number of competencies with a frequency of one.

[8]In the case of two task factors for which the total number of competencies (from package 04 competency factors) was seven or less, this number was reduced to two.

may be concentrated on one task factor, a supplementary process was employed to identify any additional competencies that may have been omitted due to this bias. Twenty-six competencies from the seven competency factors were identified which had not occurred frequently enough under any one task factor to be included in the process identified above. For each of these competencies, an inspection was made to identify those competencies for which a large proportion of their occurrence was concentrated on one task factor. The specific criterion for inclusion was that the frequency of occurrence on a given task factor be at least twice as great as its next highest frequency of occurrence on any other task factor.[9] (In all cases, this frequency of occurrence also was greater than one-fourth of the total frequency of occurrence across all twelve task factors.) Finally, those competency factors which had two or more competencies identified with the same task factor were judged to be related to that task factor. This process resulted in the addition of two more task factor-competency factor pairings to the list of eighteen which resulted from the earlier process.

The results of this two-stage process of pairing task factors and competency factors are contained in the next section.

Results of the Data Analysis

This section is sub-divided into three parts which contain: (1) the results of the factor analysis of task data, (2) the results of the factor analysis of competency data, and (3) discussion of attempts to relate the results of the task and competency data analyses.

---

[9]One exception was a competency that had a frequency of occurrence of six on each of two task factors and a frequency of one on only one other task factor. As a result, it was identified with both task factors.

Identification and Interpretation of General Task Factors

The Harris-Kaiser Independent Clusters transformation of the twelve general task factors resulted in the oblique factor pattern summarized in Table III. The twelve factors from this solution are identified below together with a listing and discussion of the variables which loaded on each factor. For the purpose of factor identification and interpretation, only tasks which had factor coefficients greater than .33 in absolute value are included.

Task factor 1. The principal loadings on factor 1 are from the following task variables[10]:

T49	Using computer facilities and services	.716
T46	Planning and/or selecting data analysis techniques	.669
T 3	Conceptualizing or formulating a problem or hypothesis for empirical studies	.472
T51	Interpreting, reviewing, and integrating the results of data analysis	.455
T 6	Formulating a design for a research study	.414
T47	Conducting data analyses by non-computerized methods	.391
T38	Conducting interviews	-.379
T43	Reviewing and critiquing extant educational programs and products	-.376
T48	Developing a computerized data bank and retrieval system	.374

Each task which loads positively on this factor is related to empirical research, with the heaviest emphasis being upon design and data analysis.

---

[10]Task numbers, labels for each task, and loadings are shown under each task factor.

TABLE III

Factor Pattern for Factor Analysis of Tasks
(Harris-Kaiser Independent Clusters Oblique Solution)

TASK	FACTOR											
	1	2	3	4	5	6	7	8	9	10	11	12
T1	191						-137	522	-120	135		
T2						209	-179	639				147
T3	472			-142	-203			127	-257		271	-156
T4	-213	-208		-150	-500	158		181	-224	-108		
T5	-187	321	510		-114		-151	126	-101			-189
T6	414	-107	157	101					-189	387	136	
T7	195		-143	549						-156	-175	-103
T8		448	523			160	-108			108		
T9				671	159			112	-125			
T10		-157		460	139	120				-364		104
T11			275		-167	-118		-254	-380	-221	-130	
T12	154		539				141		220		163	
T13		190	370			124	124					
T14	-134	-277	443	-202	-181	-182	241		-225	-130	153	
T15		-136	574	183	122		121				136	
T16			263	-191	-164	-135		-252		-157	-197	-135
T17	150				335		234	110		495		
T18							754				-127	
T19							826					
T20	-187		346	160		232			149	-249	152	180
T21	190	127	584		140				-175			-118
T22	102								177		626	
T23	-138		222		289	-180		171	164	115	407	
T24		-261	288		-116			-102			441	
T25	162	633	125	141	-137							
T26		814					161			125		
T27	-227	-209		-140	-117	-188	-143	195			-162	114
T28		763	181									
T29		597		-173	325		-168		-143			189
T30		378		-151				-113			386	
T31	-104	237	-179	-144	106				-126	-249	460	
T32		-193		-244	105		178		-155	240	378	
T33	292		110	409	-196					-199	107	
T34	283	296		283						119		381
T35	129		133	572	-140			-130				

NOTE: Only factor pattern coefficients greater than .100 in absolute value are shown. Leading decimal points are omitted.

TABLE III

Factor Pattern for Factor Analysis of Tasks
(Harris-Kaiser Independent Clusters Oblique Solution)

TASK	FACTOR											
	1	2	3	4	5	6	7	8	9	10	11	12
T36				723		-122	-221			145		
T37												809
T38	-379	-106		366	-279	-132		124				324
T39		-122		429				-312		173		279
T40		270	-215	157						510		174
T41		167	-290	320	-190					109	401	
T42	152		-341	123	-373	152			-191			-247
T43	-376	223	-208	237	-219	-115	183	220		243		-116
T44	-168	463					-251			-271	111	
T45	109			-104	-116							523
T46	669		220	162						111		
T47	391		-158					-106	-182		142	205
T48	374		-124						294	-179		-222
T49	716		-112				104		171			
T50								-155	567			
T51	455		-133					137		-447		
T52	157	-104		-125			-102		654			
T53	319	-287		-114				142	-305			-154
T54		-174		151	382	-266		316		-231	-101	
T55	-254		-217		227		118	277		-177	119	-166
T56	194					-161		507		-143		
T57		-135			343	192			-208		192	
T58	-142	-171	115	167	538	254			-150			
T59		134	205	177			224	289	105			202
T60	202			-255	111			203		-335	147	218
T61					114	158	272	276	151	-240	196	-169
T62							464	-195		-177	-215	-118
T63	-220	236	-236	349			138	-125	-189	-281		-108
T64			-123	-205	361			-203	-291	-181		293
T65				-106		585		122				240
T66						891						
T67						811						
T68	125	-209		109			-131	-191	-277	129	368	125
T69						317	226			-170	259	
VARIANCE OF FACTORS	3.227	3.764	3.061	3.473	2.081	2.607	2.340	2.127	2.047	2.210	2.260	2.140

NOTE: Only factor pattern coefficients greater than .100 in absolute value are shown. Leading decimal points are omitted.

Tasks 49, 46, 47 and 48 all deal with some aspect of computer utilization or data analysis. Tasks 3 and 6 deal with formulation of a problem or research design, while the remaining variable with a positive loading, task 51, deals with interpretation of data and data analysis. Therefore, task factor 1 is named designing research studies and conducting and interpreting data analyses.

Task factor 2. Task factor 2 is named developing instructional materials in accord with the following variables which possess high loadings on it:

T26	Specifying and sequencing learning activities	.814
T28	Designing curriculum materials	.763
T25	Identifying and formulating educational objectives	.633
T29	Writing or revising printed curriculum materials	.597
T44	Field testing of curriculum materials	.463
T 8	Designing a specific educational development activity	.448
T30	Developing non-textual learning materials	.378

Each of these variables is clearly part of the process of developing instructional materials.

Task factor 3. The following variables loaded on this factor:

T21	Supervising professional personnel	.584
T15	Allocating human and material resources to activities	.574
T12	Formulating budgets and conducting cost-analyses	.539
T 8	Designing a specific educational development activity	.523

T 5	Identifying a product or program which needs to be developed	.510
T14	Engaging in executive planning and policy-making	.443
T13	Utilizing a PERT or other management planning system	.370
T20	Orienting, training and upgrading project personnel	.346
T42	Tabulating and categorizing data	-.341

Six of the eight variables which load positively on the factor, including the three highest loadings, refer to management or administration tasks. The other two with positive loadings (T8 and T5) are development tasks with an emphasis on those aspects of development in which a higher level administrator likely would be involved. Several of the positive loadings are on variables which have to do with broad-scale planning, policy-making and supervision. To distinguish this factor from task factor 11 (which is also an administration and management factor but focused on tasks that are characteristic of persons who have a lower level position in a project or program hierarchy), general task factor 3 is named "first-level" administration of inquiry and inquiry-related projects and activities.

Task factor 4. The highest loadings on this factor are from the following variables:

T36	Selecting or constructing and revising questionnaires, checklists, interview schedules, and observation systems	.723
T 9	Conducting, managing, or monitoring a formative evaluation	.671
T35	Selecting or constructing and revising measures of affect	.572
T 7	Formulating a design or plan for an evaluation	.549

T10	Conducting, managing, or monitoring a summative evaluation	.460
T39	Administering group tests and collecting data by use of paper and pencil instruments	.429
T33	Planning data collection procedures	.409
T38	Conducting interviews	.366
T63	Conducting inservice education programs	.349

The eight variables which load highest on this factor specifically refer to either evaluation tasks or data collection tasks which are, of course, a necessary part of evaluation activities. Although many of the types of data collection specified in the tasks (e.g., T36, T35, T39 and T38) are common techniques for collecting research data, their loading with evaluation tasks on this factor suggests that they may be used more frequently by evaluators -- indeed, some of these techniques may be among the evaluator's most useful tools. Therefore, task factor 4 is named conducting evaluations and constructing and using data collection instruments.

Task factor 5. The highest loadings on this factor are from the following variables:

T58	Disseminating information about activities on a specific project or in a specific agency	.538
T 4	Conducting philosophical and historical analyses	-.500
T54	Preparing and delivering a lecture or oral presentation on a research or research-related topic	.382
T42	Tabulating and categorizing data	-.373

T64	Translating written materials from one language to another	.361
T57	Preparing reports, educational materials, and other printed materials for mass production	.343
T17	Preparing RFPs and guidelines for preparation of proposals	.335

The largest loadings are related to tasks 58 and 4. There appears to be no compelling reason for these two variables to load, albeit in opposite directions, on the same factor.[11] However, in deference to the slightly higher (in absolute value) loading of T58 and the fact that the four remaining positive loadings are on variables clearly related to diffusion, task factor 5 is named diffusing information and products.

Task factor 6. The three principal loadings on this factor are from the following variables:

T66	Selecting and indexing documents for inclusion in information storage and retrieval systems	.891
T67	Writing abstracts of materials selected for inclusion in an information storage and retrieval system	.811
T65	Developing and modifying information storage and retrieval systems	.585

All three of these variables are tasks that are part of developing and operating information storage and retrieval systems such as ERIC centers. Thus, general task factor 6 is named developing and operating information storage and retrieval systems.

---

[11] It could be that task 4 (and task 42) refer to activities more likely to be pursued by someone conducting research per se, an unlikely pursuit for a disseminator. However, this must be viewed as speculation at this point.

Task factor 7. The principal loadings on this factor are from the following variables:

T19	Processing proposals for funding and monitoring funded proposals	.826
T18	Reviewing and evaluating proposals submitted for funding	.754
T62	Conducting on-site evaluation visits	.464

The first two variables reflect activities engaged in by persons responsible for dispensing funds to support inquiry and inquiry-related activities in education. The analysis suggests that these same persons also conduct on-site evaluation visits to projects or programs which they have funded. Task factor 7 is named evaluating inquiry and inquiry-related proposals and monitoring funded projects.

Task factor 8. The variables which have the highest loadings on this factor are as follows:

T 2	Utilizing formal search procedures to acquire information	.639
T 1	Reading the literature and acquiring up-to-date information through other means	.522
T56	Reviewing and evaluating research and research-related reports	.507

The first two variables deal with the acquisition of information. The third variable is the task of initially reviewing reports and making judgments about the information in them. Therefore, general task factor 8 is named searching, reading, and reviewing the literature.

Task factor 9. Task factor 9 is named designing and maintaining computer systems and writing computer programs. The important loadings on this factor are as follows:

T52	Designing computer programs and programming	.654
T50	Designing computer systems, inspecting and diagnosing computer problems, and repairing computer equipment	.567
T11	Writing a proposal	-.380

This factor shows that the designing of both computer systems and programs, as well as the maintenance of systems and programming itself, tend to be done by the same persons. Such persons are typically specialists not involved in writing a proposal and, therefore, it is not startling that task 11 would load negatively on this factor.

Task factor 10. The following variables possessed high loadings on this factor:

T40	Administering individual tests	.510
T17	Preparing RFPs and guidelines for preparation of proposals	.495
T51	Interpreting, reviewing, and integrating the results of data analysis	-.447
T 6	Formulating a design for a research study	.387
T10	Conducting, managing, or monitoring a summative evaluation	-.364
T60	Negotiating with publishers and equipment manufacturers	-.335

It is not readily apparent why this subset of task variables loaded together on this factor. Consequently no name has been given to this factor.

Task factor 11. Task factor 11 is named "second-level" administration of inquiry and inquiry-related projects and activities. The principal variables loading on this factor are as follows:

T22	Supervising support personnel	.626
T31	Producing or supervising the production of curriculum materials in quantity	.460
T24	Designing and selecting facilities and capital equipment	.441
T23	Hiring and recruiting personnel	.407
T41	Using formal or informal observation systems to code human behavior	.401
T30	Developing non-textual learning materials	.386
T32	Repairing and maintaining equipment (other than computers)	.378
T68	Conducting a research study	.368

The first four variables have an administrative emphasis as indicated by their inclusion of supervision (T22 and T31), selection of facilities and equipment (T24), and hiring of personnel (T23). As noted earlier, this factor seems to have a somewhat different character than task factor 3, the "first-level"administration factor, in that the tasks here are focused more upon the management of on-going activities and supervision of support personnel (e.g., clerks and technicians). The additional four variables that load on this factor (albeit with lower coefficients) cover a variety of operational tasks and suggest that (1) "second-level" administrators are found in a variety of inquiry and inquiry-related activities and (2) managers at this level often are directly involved in the operations which they manage.

Task factor 12. Task factor 12 is named developing and scoring tests in accord with the following variables which loaded on this factor:

T37	Scaling, norming and establishing reliability and validity of measuring instruments	.809
T45	Scoring tests	.523
T34	Selecting or constructing and revising ability and/or achievement tests	.381

The persons engaged in this group of tasks appear to be test specialists who are principally involved in the development of tests.

Intercorrelations among task factors. Study of the intercorrelations among the twelve factors described above is also informative; such intercorrelations are presented in Table IV. Only three of these correlation coefficients are greater than .2 in absolute value; these three are all positive correlations. The largest of these correlations (.270 between task factors 1 and 4) suggests some association between research and evaluation, which is not surprising. An inspection of the task variables in each of these two factors points to the use of data as the strongest link between them. The next strongest of these correlations (.229 between factors 3 and 11) is between the two administration factors. The third strongest association (.208 between factors 5 and 11) suggests that some of the same persons who are engaged in "second-level" administration activities may also be responsible for the dissemination of information about their project or program.

Task factor frequencies. The frequency with which each task factor was performed by the subjects in the sample is reported in Table V. Each subject who performed one or more of the tasks loading on a given task factor was counted once and only once in the tally on that factor.

TABLE IV

Correlations Among Oblique Task Factors

Factor	1	2	3	4	5	6	7	8	9	10	11	12
1		-142	-032	270	-124	-180	-088	106	-031	-016	002	190
2			135	-002	060	-130	-077	-110	-142	101	144	134
3				-046	044	-058	157	107	-052	036	229	-160
4					-028	-129	075	-008	-128	-073	-042	178
5						037	-058	-032	038	-080	208	-018
6							-047	002	065	005	-074	004
7								-023	-009	-072	041	-058
8									-055	-019	-035	-051
9										-043	-026	-035
10											-049	-011
11												-017
12												

NOTE: Leading decimal points are omitted.

TABLE V

Number of Subjects Who Performed One or More Tasks Under Each Task Factor

TASK FACTOR	N PERFORMING TASK(S) UNDER THIS FACTOR
1	98
2	70
3	101
4	85
5	88
6	5
7	22
8	64
9	49
10	76
11	62
12	35

In view of the fact that the maximum frequency possible in Table V for any task factor is 116 (the number of subjects in the study), the overall frequencies appear to be relatively high. In addition to the fact that a person was entered in the tally if he was involved in even one task out of the several in each task factor, the high frequencies suggest that many subjects are involved in a variety of diverse tasks. This point is borne out by inspection of the original data and is also consistent with the multiple functions of many of the agencies in which members of the sample were employed (see Technical Paper No. 18).

The two factors with the lowest frequencies and the two factors with the highest frequencies deserve specific study (although not simply because of the extremity of their occurrence). The low frequency (5) for task factor 6 -- developing and operating information storage and retrieval systems -- is apparently due to the fact that the factor includes tasks which were almost exclusively limited to members of one ERIC information retrieval center. The frequency (22) of task factor 7 -- evaluating proposals and monitoring funded projects -- is higher than might be anticipated in view of the type of agencies sampled. However, inspection of the frequencies of each specific task appearing in that factor (tasks 18, 19 and 62) is revealing. Frequencies for each specific task are shown in Table VI. In looking at task 19, it is apparent that only seven persons were involved in the processing of proposals and monitoring of the funded projects -- activities peculiar to agencies which provide some funding support. The other two tasks (T18 and T62) are tasks in which persons in a variety of agencies are often engaged, e.g., through serving on review panels.

At least two factors may contribute to the high frequency (101) for task factor 3 -- "first-level" administration. First, this task factor includes a relatively large number of tasks (9). Second, it may indicate that many persons in R & D organizations enter into "higher-level" decision-making processes at least occasionally during their employment in the type of agencies sampled. Also, the sample was chosen to include a number of administrators at each level, resulting in many persons who would be routinely expected to perform higher-order administrative duties as part of their job. The relatively high frequency (98) for task factor 1 -- designing

TABLE VI

Number of Subjects Who Performed
Each of 69 Specific Tasks

TASK	N PERFORMING TASK	TASK	N PERFORMING TASK
T1	41	T36	47
T2	44	T37	11
T3	40	T38	24
T4	17	T39	24
T5	31	T40	3
T6	38	T41	17
T7	47	T42	24
T8	28	T43	24
T9	35	T44	24
T10	19	T45	8
T11	39	T46	43
T12	28	T47	25
T13	31	T48	10
T14	49	T49	44
T15	55	T50	3
T16	25	T51	47
T17	5	T52	11
T18	11	T53	81
T19	7	T54	43
T20	30	T55	7
T21	42	T56	24
T22	26	T57	25
T23	28	T58	35
T24	8	T59	29
T25	37	T60	9
T26	18	T61	23
T27	12	T62	17
T28	24	T63	37
T29	22	T64	2
T30	17	T65	3
T31	8	T66	4
T32	3	T67	3
T33	43	T68	13
T34	31	T69	7
T35	18		

research studies and conducting and interpreting data analyses -- is probably due to the reliance of research, evaluation and product testing (part of development) on analyzing data and interpreting results.

Identification and Interpretation of Competency Factors

The oblique transformation (Harris-Kaiser Independent Clusters solution) of the seven factors obtained from the factor analysis of competency data in package 04 (as described in the previous section) resulted in the factor pattern summarized in Table VII. The factors in this pattern are identified below. For the purpose of factor identification and interpretation, only competencies which possessed pattern coefficients greater than .30 in absolute value were used.

TABLE VII

Factor Pattern for Factor Analysis of Package 04 Competencies
(Harris-Kaiser Independent Clusters Oblique Solution)

COMPETENCY	FACTOR						
	1	2	3	4	5	6	7
C102	325	439				210	-105
C105		416			120	160	
C106	-118	574	-102	371		-100	
C107	-131	367				-171	160
C109	154	449		-167	-114		
C115		676					
C116		467				-121	
C202		303	-273		102	262	144
C203	-182	156	-166		234	214	295
C205	501	138	139		207	175	-135
C206	332	363				-121	
C208	363	263	-141		-281		
C209	-156			494	-430	135	
C211	243	206	-108	105	223	-166	328
C218	166		-269	280	-118	133	231
C223	345	152		159	342	-122	
C302	178	249	275		-198	278	-101
C304	314	197	100	230	-120		151
C307		261	109	166	-257	-178	456
C310		154			-160	471	
C312		-140				755	
C363				661			
C371	-146	-256	-121	271	245		352
C374				633	-188		
C404		-151	388	155	142	-147	
C408	413		211		111		-195
C409	-159		514		113		258
C412			520	142			166
C413	-111		424				
C415	-159		158	-208			
C417	-105		433	-136	-323		177
C420			-148		343	-191	285
C501	-209	-159		329	225		176
C502	-125	-295		345	270		293
C541				582	193		
C543		222		584	182		-167
C603						629	

NOTE: Only factor pattern coefficients greater than .100 in absolute value are shown. Leading decimal points are omitted.

TABLE VII

Factor Pattern for Factor Analysis of Package 04 Competencies
(Harris-Kaiser Independent Clusters Oblique Solution)

COMPETENCY	FACTOR 1	2	3	4	5	6	7
C604		243				594	
C607	-240	-145		-319		325	
C608			-111		487	261	-164
C609					373	-185	
C10		304		-105	369	108	
C611	-204			-232	282	354	229
C613	-102	547				202	
C614				113	538		183
C616		104			339		-106
C617	-183	110	-100	-112	221	337	251
C620	141		112		449		-168
C622		333	-243	-210	263	-133	-104
C625					356	180	249
C629	-222	432		-144	238	-248	
C729	-236			529			179
C801	388					286	371
C802	282		193		-243	-156	283
C807	530		138	206	-129		
C810			145		-176		542
C811	571					-112	
C812					136		654
C815	488				-145	210	105
C819			109	-131	-118		650
C822	565				141	-212	130
C824	623		-175	-110			-247
C825	466	-158	-285	-137		-103	
C826	691	-214	-147			164	177
C828	149		-182	-315			366
C830	558			-151			
C831	502		-212	-166		-113	292
C832	525	-118	-187				

NOTE: Only factor pattern coefficients greater than .100 in absolute value are shown. Leading decimal points are omitted.

TABLE VII

Factor Pattern for Factor Analysis of Package 04 Competencies
(Harris-Kaiser Independent Clusters Oblique Solution)

COMPETENCY	FACTOR 1	2	3	4	5	6	7
C911	-103		565		-142		
C912	-170		462	-128			
C916	-217		-188				512
C917	328	-145	228	-119	200		
C001	122	-315			478		
C002	346	-106	179		352		
C004			511	-202	131	115	
C005	292	-250	114		194		-139
C009	196	392	115			-107	
C010		281	149	-147	444	-148	
C013	372		461	119	155	-111	
C015		146	388		193		107
C017	429	-124			193	176	-178
C018					290		-281
VARIANCE OF FACTORS	5.891	4.033	3.371	3.537	3.904	3.133	3.621

NOTE: Only factor pattern coefficients greater than .100 in absolute value are shown. Leading decimal points are omitted.

Competency factor 1. The principal loadings on this factor are from the following competencies:

C826	Ability to design card layouts to allow data analysis within computer constraints and ability to use standardized computer programs (e.g., BMD series)	.691
C824	Knowledge of how computers might be used to analyze data	.623
C811	Knowledge of t-tests and critical ratios	.571
C822	Knowledge of alternate methods of presenting statistical data (e.g., charts, graphs, or tables)	.565
C830	Ability to use computer coding	.558
C807	Knowledge of ANOVA or ANCOVA designs and techniques	.531
C832	Ability to read and interpret computer output	.525
C831	Ability to keypunch	.502
C205	Knowledge of questionnaire construction techniques and appropriate uses for questionnaires	.501
C815	Knowledge of factor analysis techniques	.488
C825	Ability to allocate time and money wisely in arranging computer work	.466
C017	Ability to describe, explain, or elaborate in writing	.429
C408	Ability to formulate a rationale to support a particular position or argument	.413
C801	Ability to choose (or design) appropriate statistical techniques for data analysis	.388
C013	Ability to write in an interesting or appealing style	.372

C208	Knowledge of norming procedures	.363
C002	Ability to revise and rewrite	.346
C223	Ability to arrange items in a format which is easy to read	.345
C206	Ability to construct instruments to assess attitudes and other affective variables	.332
C917	General speaking skills	.328
C102	Ability to discuss the advantages of establishing evaluation systems in educational institutions	.325
C304	Knowledge of specific experimental and quasi-experimental research designs	.314

The competencies which possess high pattern coefficients on this factor include skills and knowledge related to analysis of data (C826, C811, C807, C815, C801), computer operations and utilization (C826, C824, C830, C831, C832, C825), instrument development and measurement (C205, C208, C223, C206), and reporting (C822, C017, C013, C002). Therefore, factor 1 is named data collection, processing, analysis and presentation competencies.

A second factor, competency factor 7, also has its principal loadings from variables similar to those on competency factor 1. Variables with principal loadings on factor 7 are shown below:

C812	Knowledge of statistical variance and standard deviation	.654
C819	Knowledge of theoretical assumptions underlying various statistical techniques	.650
C810	Knowledge of statistical regression techniques	.542
C307	Ability to design studies to control extraneous variables	.456

C801	Ability to choose (or design) appropriate statistical techniques for data analysis	.317
C828	Knowledge of capabilities of local computer systems	.366
C371	Ability to draw or compose pictures or illustrations for curriculum materials	.352
C211	Ability to construct items that measure what one sets out to measure	.328

The competencies which possess high pattern coefficients on this factor include skills and knowledge related to analysis of data (C812, C819, C810, C801), computer operation and utilization (C828), instrument development (C211), and research design (C307). The highest loadings and a majority of variables relate to statistics and competency factor 7 is therefore named statistical competencies. Admittedly, there is a large area of overlap between competency factors 1 and 7 ($r = .32$). The difference seems to be one of emphasis rather than coverage, with loadings on factor 7 clustering primarily on only one of the areas of competency included in factor 1.

Competency factor 2. The principal loadings on this factor are the following:

C115	Ability to incorporate systematic evaluation procedures into plans for developing educational programs	.676
C106	Ability to work with public school, university or state department of education personnel	.574
C613	Ability to identify educational needs that should be addressed by educational systems	.547
C116	Ability to develop techniques for providing evaluative feedback to program or project personnel in time to allow needed modifications to be made during the operation of the program	.467

C109	Ability to help others identify and state their objectives	.449
C102	Ability to discuss the advantages of establishing evaluation systems in educational institutions	.439
C629	Ability to work effectively with decision makers	.432
C105	Knowledge of personnel and the organizational structures of public school systems and universities	.416
C009	Ability to put quantitative or numerical information into verbal or narrative form	.392
C107	Ability to determine the evaluative questions which must be asked in evaluation and the information which must be gathered to answer these questions	.367
C206	Ability to construct instruments to assess attitudes and other affective variables	.363
C622	Ability to facilitate staff work on an ongoing project	.333
C001	Ability to write	-.315
C610	Ability to identify and obtain resources needed to accomplish program objectives	.304
C202	Knowledge of measurement theory and techniques	.303

The competencies which possess high pattern coefficients include specific evaluation competencies (C613, C116, C109 and C107), competencies relating to installing evaluation systems (C115, C102), knowledge of some tools of evaluation (C206, C202), competencies in relating to persons necessary in conducting evaluations (C106, C629), and competencies in translating numerical results into reports (C009). Therefore, competency factor 2 is named <u>evaluation competencies</u>.

Competency factor 3. The highest pattern coefficients on this factor are from the following variables:

C911	Ability to use library research techniques	.565
C412	Ability to predict with accuracy the impact of an inquiry or inquiry-related activity	.520
C409	Ability to evaluate or critique a written or oral presentation	.514
C004	Ability to synthesize or summarize	.511
C912	Ability to use ERIC or other information retrieval systems	.462
C417	Ability to make long-range forecasts or predictions	.432
C413	Ability to conceptualize or "brainstorm" new ideas	.424
C015	Ability to write clearly and/or concisely	.388
C404	Ability to be creative	.388

Four of the variables (C911, C912, C409, C004) deal with ways of acquiring or using information, one deals specifically with evaluating information (C409), two relate to forecasting competencies (C412, C417), and two to developing new ideas (C413, C404). Therefore, competency factor 3 is named ability to obtain and use information to forecast events or outcomes or develop new ideas.

Competency factor 4. This factor received its highest loadings from the following variables.

C363	Knowledge of current theories of learning, especially as they relate to theories of instruction	.661
C374	Knowledge of developmental psychology or the field of psychology in general	.633

C543	Knowledge of the role of the teacher including abilities which normally can be expected of teachers	.584
C541	Knowledge of instructional approaches that might be incorporated in teaching or designing instructional materials	.582
C729	Ability to establish rapport with children and obtain their cooperation in testing situations	.529
C209	Knowledge of theory and techniques for assessing student achievement	.494
C502	Knowledge of printing constraints and specifications	.345
C501	Knowledge of steps involved in the mass production of curriculum materials (e.g., reproduction and packaging processes)	.329
C828	Knowledge of capabilities of local computer systems	-.315

The first six of these nine variables, which have positive coefficients of .49 or above, are consistent with naming competency factor 4 knowledge of students, teachers, and educational and psychological processes.

Competency factor 5. The following variables possessed high loadings on this factor:

C614	Ability to determine financial resources necessary to conduct a program or project and use accounting procedures to operate within a program or project budget	.538
C608	Ability to supervise personnel	.487
C001	Ability to write	.478
C620	Ability to outline specific procedures for working through a problem	.449

C010	Ability to write in a style and at a level appropriate to a specified audience	.444
C209	Knowledge of theory and techniques for assessing student achievement	-.430
C609	Knowledge of effective techniques for writing and submitting proposals to obtain funding	.373
C610	Ability to identify and obtain resources needed to accomplish program objectives	.369
C625	Ability to make progress assessments for ongoing activities	.356
C002	Ability to revise and rewrite	.352
C420	Knowledge of legalities related to inquiry or inquiry-related projects	.343
C223	Ability to arrange items in a format which is easy to read	.342
C616	Knowledge of and ability to use management and planning systems such as PERT (Program Evaluation and Review Technique), PPBS (Program Planning Budgeting System), or Critical Path Analysis	.339
C417	Ability to make long-range forecasts or predictions	-.323

Of the 14 competencies loading on this factor, seven (C614, C608, C620, C609, C610, C625 and C616) are specific administrative competencies related to the operation of research and research-related projects or programs. The competency related to legal aspects of conducting such activities (C420) is consistent with competencies related to the production of proposals (C609), formulation of budget-accounting procedures (C614) and the supervision of personnel (C608). Similarly, the three writing competencies which load on this factor (C001, C010, and C002) are not surprising. For example, the ability to write to a given audience (C010) is

complementary to competency C609, the presentation and production of proposals to obtain funding. Competency C002--an editing competency--is often employed by senior researchers or project directors. It is not readily apparent why competency C223, which is concerned with the technical aspects of the form of a test or other type of measuring instrument, loads positively on this factor. Competencies C209 and C417, which both load negatively, are not of an administrative nature. Consequently, factor 5 will be named operational administrative competencies.

Competency factor 6. The following variables have the principle loadings on this factor.

C312	Ability to plan effective development procedures	.755
C603	Knowledge of inquiry or inquiry-related management	.629
C604	Knowledge of the role of inquiry and inquiry-related activities in education	.594
C310	Knowledge of methods for planning or installing a complete curriculum or a curriculum package	.471
C611	Knowledge of personnel evaluation practices	.354
C617	Knowledge of effective techniques of recruiting, interviewing, and hiring personnel	.337
C607	Knowledge of the organization for which you are working, including knowledge of its needs, resources, methods of operation, etc.	.325

The competencies described above are needed by persons in policy making and higher level administrative positions. Two competencies deal specifically with planning (C312 and C310), one (C603) with project or program management, two (C604 and C607) with knowledge of the employing

organization or the roles played by persons within it, and two (C611 and C617) with the employment and evaluation of personnel. Competency factor 5 and competency factor 6 are both related to administration, with the difference being one of levels of functioning. Factor 6 includes competencies related to policy and decision making on projects and programs related to educational inquiry. In contrast, the competencies which possess high loadings on factor 5 are related more to the actual operation of such projects or programs. In accord with this distinction, competency factor 6 will be named policy making and decision making competencies.

Competency factor 7 was previously named statistical competencies. Because of its close relationship to competency factor 1, this factor and variables having principle loadings on it were discussed earlier along with competency factor 1.

Intercorrelations among competency factors. The intercorrelations among the seven competency factors are shown in Table VIII. The two correlations greater than .15 in absolute value are both understandable in view of the nature of the relevant factors. The highest correlation, that of .318 between factors 1 and 7, is reasonable in that both factors are related to data analysis or data analysis tools. The correlation between factors 5 and 6 (.162) is reasonable in that both are administrative factors. The fact that the correlation is low suggests that the same person uses both operational and policy-making administrative competencies only on a small subset of projects or programs.

Table VIII

Correlations Among Oblique Competency Factors: Package 04

Factor	1	2	3	4	5	6	7
1		139	-018	-010	-113	-043	318
2			-093	-007	001	108	-064
3				-110	136	-049	-008
4					-039	-023	042
5						162	-008
6							-017
7							

Note: Leading decimal points are omitted.

Additional competencies added to each competency factor. Upon completion of the factor analysis of package 04, the combination of empirical and logical procedures described in the previous section on data analysis procedures was used to add additional competencies to those contained in the original seven factors. In each case, the variables added by the empirical-logical procedure were consistent with the identification and interpretation of each factor that resulted from the factor analysis of package 04. Table IX contains a final listing of the competencies included under each of the competency factors. The competencies determined by the factor analysis of package 04 are listed first, above the solid line in each column. The competencies added through the empirical-logical procedure are listed below the solid line in each column, with those added based on logical grounds only included in parentheses.

Table IX

Summary of Placement of Competencies Within Competency Factors

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
C102	C102	C404	C209	C209	C310	C211
C205	C105	C409	C363	C223	C312	C307
C206	C106	C412	C374	C417	C603	C371
C208	C107	C413	C501	C420	C604	C801
C223	C109	C417	C502	C608	C607	C810
C304	C115	C911	C541	C609	C611	C812
C408	C116	C912	C543	C610	C617	C819
C801	C202	C004	C729	C614	C112	C828
C807	C206	C015	C828	C616	C606	C201
C811	C610	C101	C361	C620	C614	C304
C815	C613	C217	C366	C625	C906	C305
C822	C622	C313	C368	C001	C601	C306
C824	C629	C405	C373	C002	C602	C366
C825	C001	C406	C375	C010		C804
C826	C009	C407	C376	C210		C808
C830	C103	C408	C401	C414		C823
C831	C104	C415	C402	C630		C827
C832	C108	C416	C411	C902		C834
C917	C110	C615	C421	C905		C308
C002	C111	C618	C506	C915		(C204)
C013	C113	C904	C507	C018		(C215)
C017	C114	C906	C508	C628		(C221)
C301	C118	C915	C545	C615		C309
C302	C119	C401	C701	C627		C314
C303	C203	C903	C702	C601		C808
C701	C207	C001	C914	C602		C821
C802	C378	C005	C904	C619		(C011)
C806	C628	C014	C210	C621		
C804	C726	C003	C905	C623		
C805	C803	C006	C204	C624		

Table IX, continued

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
C808	C804	C411	C215	C626		
C814	C805	C907	C308			
C816	C813	C908	C364			
C817	C904	C018	C403			
C903	C003	C418	C504			
C918	C006	(C623)	C505			
C919	C630	C913	C548			
C001	C112	C016	(C619)			
C005	C212		(C621)			
C014	C012		(C624)			
C015	C204		(C626)			
C212	C215		(C727)			
C305	C221		C728			
C112	C308		C821			
C204	C309		C901			
C215	C314		C918			
C221	C403		C011			
C308	C623		C016			
C309	(C624)					
C314	(C626)					
(C403)	C727					
C808	C728					
C821	C821					
C901	C901					
C011	C918					

NOTE: The competencies determined by the factor analysis of package 04 are listed first, above the solid line in each column. The competencies added through the empirical-logical procedure are listed below the solid line in each column. Competencies placed in the competency factors on purely logical grounds are enclosed by parentheses.

This listing represents seven groups of competencies that tend to be held in common by certain individuals who are engaged in exemplary research and research-related work. Thus, the analysis has identified seven "types" of individuals in terms of the competencies they possess. In the next section the relationship between these competency factors and the 12 task factors will be explored.

Relationships Between Competency Factors and Task Factors

The two stage empirical process described in the previous section on the results of the data analysis was used to pair the competency factors and task factors. The data used in this process were the frequency of occurrence of competencies within task factors presented in Table X. The first stage in the process resulted in eighteen competency factor-task factor pairings, with two additional pairings added as the result of the second stage. The results are listed in Table XI and discussed under each task factor below.[12] Each task factor will also be considered as defining a broad inquiry or inquiry-related function in the discussions in the remainder of this paper.[13]

---

[12]One qualification needs to be made concerning these relationships. Competencies required for the performance of each task factor are not necessarily limited to those contained in the competency factors paired with the task factor here. Although the most widely used competencies were identified in the factor analysis, inspection of the frequency of occurrence of each competency within each task factor (Table X) shows that many additional competencies are used, albeit not frequently.

[13]See definition of "function" on page 7 of this paper.

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR 1	2	3	4	5	6	7	8	9	10	11	12
C101	1	1	2	1	3	0	0	1	1	1	1	6
C102	3	6	7	19	5	0	2	0	3	5	2	2
C103	20	16	36	35	23	1	8	6	5	13	12	3
C104	4	5	14	8	4	0	2	3	2	0	2	3
C105	10	12	17	23	7	0	3	6	3	6	5	0
C106	6	15	12	23	2	0	2	1	1	6	5	1
C107	2	0	2	7	1	0	1	2	0	1	0	0
C108	2	8	9	20	2	0	6	0	0	2	5	1
C109	3	5	9	17	1	0	2	0	2	4	0	0
C110	9	8	7	27	2	0	4	2	2	3	1	1
C111	3	2	3	10	4	0	2	3	0	2	0	0
C112	12	5	5	17	1	0	2	1	1	4	3	1
C113	0	3	6	4	2	0	2	1	1	0	1	1
C114	5	1	3	4	0	1	3	0	0	2	0	9
C115	1	2	2	9	0	0	0	0	0	1	0	3
C116	2	2	0	3	0	0	0	0	0	0	0	2
C117	0	1	1	1	0	0	0	0	1	0	0	0
C118	0	2	4	6	0	0	0	0	0	2	1	1
C119	0	1	2	3	2	0	0	0	0	1	0	1
C201	5	2	1	8	0	0	0	1	0	0	1	0
C202	11	8	10	22	1	0	2	0	3	8	3	3
C203	2	4	1	1	0	0	0	0	1	2	1	1
C204	12	4	4	19	1	0	0	1	0	3	1	7
C205	2	3	5	16	2	0	0	0	0	3	1	0
C206	1	2	1	11	0	0	1	0	0	1	0	0
C207	10	5	4	15	0	0	0	1	2	5	0	2
C208	6	2	1	3	0	0	0	0	0	3	0	0
C209	3	7	2	2	1	0	0	1	0	1	1	2
C210	3	6	4	3	2	0	0	0	0	0	1	1
C211	2	1	0	17	0	0	0	0	0	0	0	2
C212	0	0	0	13	0	0	0	0	0	0	0	1
C213	1	0	0	5	0	0	0	0	0	0	0	0
C214	0	0	0	0	0	0	0	0	0	0	0	1
C215	1	0	1	6	0	0	0	0	0	1	0	2
C216	0	0	0	4	0	0	0	0	0	0	0	0
C217	1	0	0	11	0	0	0	0	0	0	1	0
C218	11	2	1	4	1	0	0	1	0	5	0	4
C219	0	0	0	2	0	0	0	0	0	2	1	1

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR 1	2	3	4	5	6	7	8	9	10	11	12
C220	1	0	0	2	0	0	0	0	0	1	0	0
C221	2	1	2	12	1	0	1	1	2	1	1	2
C222	0	1	0	0	0	0	0	0	0	0	0	0
C223	0	3	0	8	4	0	0	0	0	1	0	2
C301	9	2	3	6	2	1	2	4	2	9	3	1
C302	5	2	5	9	2	0	0	0	3	5	1	0
C303	11	2	6	10	2	0	2	4	1	9	1	1
C304	24	4	4	9	1	0	0	1	7	19	2	2
C305	17	3	6	11	1	0	0	3	3	13	3	2
C306	19	10	18	12	0	1	2	1	5	15	4	1
C307	12	0	3	14	1	0	0	1	3	10	1	0
C308	14	5	3	12	2	0	0	6	1	9	5	1
C309	22	3	6	21	1	0	0	3	2	17	2	2
C310	0	3	2	2	0	0	0	0	0	1	0	0
C311	1	1	1	4	0	0	0	0	0	1	0	0
C312	0	6	6	0	0	0	0	0	1	0	0	0
C313	6	2	8	6	1	1	1	2	2	2	0	1
C314	15	1	2	11	6	1	1	1	0	4	0	1
C361	4	11	10	6	3	1	0	6	2	2	1	0
C362	0	4	4	1	3	0	0	0	0	0	1	1
C363	7	12	11	6	2	0	0	5	1	5	2	1
C364	2	3	3	3	2	0	1	1	1	1	1	0
C365	2	2	2	2	3	1	0	1	0	1	2	0
C366	1	8	2	3	0	0	0	1	0	0	3	0
C367	0	1	1	0	0	0	0	0	0	0	0	0
C368	1	13	7	7	1	0	2	0	1	2	4	0
C369	2	1	2	1	0	0	0	0	0	0	0	0
C370	0	1	0	0	0	0	0	0	0	1	2	0
C371	1	5	0	2	8	0	0	0	0	2	3	2
C372	0	5	1	0	0	0	0	0	0	0	0	0
C373	4	2	1	3	0	0	0	0	0	3	0	0
C374	13	12	10	9	4	0	1	8	0	7	8	2
C375	0	4	2	1	0	0	0	2	1	0	0	0
C376	4	16	11	4	2	0	0	4	1	0	1	0
C377	0	0	0	0	3	0	0	0	0	0	0	2
C378	0	1	2	4	4	0	0	0	0	0	1	2
C401	31	24	38	24	25	5	3	28	9	19	11	6
C402	4	11	12	3	4	0	1	7	0	2	1	1

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR 1	2	3	4	5	6	7	8	9	10	11	12
C403	1	3	1	2	1	0	0	1	0	0	1	1
C404	2	3	2	0	5	0	0	1	2	2	1	1
C405	18	13	20	12	18	3	2	11	7	4	4	2
C406	10	1	1	1	5	0	0	8	0	6	0	0
C407	11	7	12	6	7	1	0	6	3	5	2	4
C408	2	2	2	4	4	1	1	3	4	1	2	0
C409	20	21	23	22	16	5	9	29	4	11	10	2
C410	1	0	1	0	1	0	0	0	0	0	0	0
C411	6	8	8	4	3	1	0	4	2	4	0	0
C412	1	0	5	2	2	0	0	0	2	0	0	1
C413	7	5	13	3	10	1	0	5	4	1	2	0
C414	0	3	7	1	1	0	0	0	2	0	2	0
C415	2	1	3	1	2	1	0	2	2	0	0	0
C416	3	3	7	1	5	0	0	3	1	1	0	1
C417	4	2	1	0	7	0	0	3	0	2	1	8
C418	4	3	5	4	3	0	0	2	1	1	0	1
C419	1	0	0	0	2	0	0	2	0	0	0	7
C420	1	2	3	4	0	1	0	1	0	1	0	2
C421	11	25	21	28	7	0	3	1	5	9	8	3
C422	0	2	1	0	1	1	0	1	1	0	1	6
C501	1	2	4	0	5	0	0	1	1	0	5	4
C502	0	2	1	0	11	1	0	0	0	1	3	2
C503	0	1	0	0	1	0	0	0	0	3	0	0
C504	0	0	4	0	1	0	0	0	0	1	3	0
C505	0	2	1	0	4	0	0	0	0	0	2	1
C506	0	3	0	0	1	0	0	0	0	0	3	1
C507	0	10	0	2	1	0	0	0	0	1	10	0
C508	0	5	3	0	2	0	0	0	0	0	3	4
C509	0	0	0	0	0	0	0	0	0	0	2	0
C541	5	17	8	9	5	1	1	3	1	1	5	4
C542	2	4	3	6	0	0	0	0	1	1	0	0
C543	5	18	17	16	5	1	1	4	0	0	8	3
C544	0	0	1	3	0	0	0	0	0	0	0	0
C545	7	13	16	14	7	1	2	3	0	4	6	0
C546	0	0	0	1	0	0	0	0	0	0	0	1
C547	2	2	1	6	0	1	1	2	0	1	0	2
C548	0	3	2	2	0	0	0	0	0	0	1	1
C549	0	2	0	0	0	0	0	0	0	0	2	2

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR											
	1	2	3	4	5	6	7	8	9	10	11	12
C601	5	5	20	7	6	0	1	1	4	5	5	2
C602	3	3	10	1	3	0	0	2	1	1	0	0
C603	1	3	7	0	0	0	0	2	3	0	0	3
C604	1	3	8	4	2	0	0	2	0	1	0	4
C605	0	0	3	1	1	0	0	0	0	0	1	0
C606	2	10	22	5	5	0	2	1	0	2	5	0
C607	4	6	17	5	9	2	1	2	2	3	10	0
C608	10	12	54	16	7	1	4	6	4	4	24	2
C609	1	2	4	0	2	0	1	1	9	2	0	0
C610	3	10	22	10	3	0	1	0	4	3	2	0
C611	1	0	9	0	1	0	1	0	0	0	11	0
C612	0	0	1	0	0	0	0	0	0	0	0	2
C613	8	11	16	17	3	1	0	0	3	4	5	1
C614	2	8	24	5	3	0	1	1	9	1	2	1
C615	10	15	44	14	13	0	4	2	6	8	12	0
C616	1	3	12	4	1	0	0	1	0	0	2	0
C617	1	0	7	2	0	0	0	0	0	0	7	0
C618	3	3	3	2	2	0	1	5	0	0	2	0
C619	1	5	3	1	1	0	1	1	0	0	4	0
C620	4	5	17	5	3	0	1	1	6	2	6	1
C621	0	8	8	2	1	0	1	1	2	2	4	1
C622	0	2	8	6	0	0	3	0	0	0	1	0
C623	4	6	13	12	7	0	0	1	7	3	5	1
C624	1	4	13	6	7	0	3	4	1	1	6	2
C625	8	8	16	8	2	0	3	0	1	5	6	1
C626	1	1	9	3	2	0	1	0	3	0	2	0
C627	1	1	7	4	2	0	0	1	1	1	2	0
C628	4	7	18	15	9	1	3	1	1	3	5	0
C629	0	1	10	5	2	0	0	0	1	1	2	0
C630	1	2	2	2	2	0	0	0	3	1	0	0
C701	2	1	3	4	0	0	1	2	1	2	8	4
C702	1	3	4	6	2	0	5	1	0	2	11	1
C703	1	0	0	3	0	0	0	1	0	0	2	0
C726	2	1	1	4	1	0	0	0	0	3	0	2
C727	0	0	0	2	2	0	0	0	0	1	0	2
C728	1	1	0	6	0	0	1	0	0	3	2	1
C729	2	5	1	4	1	0	0	1	0	3	0	1
C801	29	2	8	12	5	0	2	3	1	15	0	1

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR											
	1	2	3	4	5	6	7	8	9	10	11	12
C802	11	0	1	2	1	0	0	2	0	6	0	0
C803	10	10	16	8	6	2	2	4	3	4	4	1
C804	22	0	3	9	2	1	2	8	3	13	2	0
C805	20	3	8	7	4	0	0	4	0	11	1	2
C806	9	0	1	4	2	0	1	0	1	5	3	3
C807	25	1	2	5	1	0	1	1	1	12	0	2
C808	20	2	3	6	2	0	0	2	0	10	0	4
C809	3	0	0	2	0	0	0	0	0	0	0	0
C810	12	1	1	3	0	0	0	1	0	3	0	2
C811	11	1	1	3	1	0	1	1	0	3	0	1
C812	4	1	2	1	0	0	0	2	0	2	0	1
C813	14	2	3	11	1	0	0	1	1	6	2	6
C814	11	2	3	11	0	0	0	1	1	5	0	4
C815	12	0	0	3	0	0	1	0	0	3	0	3
C816	14	0	2	1	0	0	1	1	0	5	0	1
C817	12	0	0	4	0	0	1	1	1	4	0	1
C818	1	0	0	1	0	0	0	0	0	0	0	0
C819	14	2	6	2	6	0	0	1	6	3	0	2
C820	1	0	0	0	0	0	0	0	0	1	0	1
C821	25	2	8	8	4	0	0	5	2	20	2	2
C822	22	0	8	6	9	0	1	1	1	8	2	1
C823	7	1	7	6	7	3	0	5	1	1	0	0
C824	20	1	5	5	0	1	0	0	0	3	1	2
C825	7	0	2	0	0	0	0	0	0	0	0	0
C826	25	1	3	4	0	0	0	0	1	5	2	5
C827	19	4	6	4	1	0	0	0	9	5	4	1
C828	10	2	2	2	0	0	0	0	9	1	3	3
C829	0	0	0	0	0	0	0	1	0	0	0	0
C830	14	0	3	2	0	0	0	0	1	0	1	2
C831	17	0	1	1	0	0	1	0	1	1	2	1
C832	12	0	0	2	0	0	0	1	3	6	1	2
C833	1	1	1	0	0	0	0	1	1	1	0	0
C834	1	2	2	4	2	0	1	0	0	1	0	1
C835	3	0	0	1	0	0	0	0	2	0	0	0
C836	0	0	0	0	0	0	0	0	0	0	0	1
C901	5	1	4	2	1	1	0	2	0	1	1	1
C902	8	8	20	19	9	0	4	1	4	6	2	1
C903	1	1	1	1	1	0	0	0	0	0	1	0

TABLE X

Frequency of Competencies Within Each Task Factor

COMPE-TENCY	TASK FACTOR											
	1	2	3	4	5	6	7	8	9	10	11	12
C904	6	1	8	8	2	0	2	4	5	2	1	0
C905	24	11	16	12	7	0	4	0	5	6	6	4
C906	0	0	4	1	1	0	0	0	0	1	1	0
C907	2	1	1	2	3	0	0	4	2	1	1	2
C908	1	2	3	1	3	0	0	9	1	0	2	1
C909	0	0	0	0	1	0	0	1	1	0	0	1
C910	1	0	2	1	1	0	0	0	0	0	0	0
C911	4	6	9	2	3	3	0	32	1	1	3	0
C912	4	0	3	1	5	4	0	18	1	1	2	0
C913	0	0	1	0	1	1	0	6	0	0	0	0
C914	5	9	4	10	7	1	0	1	0	1	7	0
C915	1	2	4	2	2	0	3	2	2	0	1	0
C916	0	0	0	0	0	0	0	1	0	1	0	0
C917	2	1	4	5	26	0	0	0	0	2	1	0
C918	1	1	4	7	19	0	1	0	0	2	0	1
C919	0	2	2	3	9	0	0	0	0	0	1	1
C920	0	0	1	3	2	0	0	0	0	0	0	1
C001	6	14	8	3	13	1	0	5	8	6	8	0
C002	5	8	4	6	5	2	1	3	4	3	2	2
C003	2	5	5	2	10	4	0	4	3	2	2	2
C004	12	4	14	6	14	3	2	14	3	6	3	0
C005	0	2	1	0	1	1	0	0	0	0	0	0
C006	2	0	4	4	2	0	0	0	2	0	1	1
C007	0	1	0	0	2	0	0	0	0	0	0	1
C008	0	0	0	0	0	0	0	1	0	0	0	1
C009	5	0	2	4	2	0	2	1	0	5	0	0
C010	3	13	15	9	21	1	1	4	5	4	1	1
C011	0	0	0	1	1	3	0	1	0	0	0	1
C012	3	7	5	3	7	0	0	4	1	3	1	0
C013	0	1	0	1	5	0	0	1	1	0	1	0
C014	11	7	12	12	20	1	0	9	9	4	7	1
C015	9	15	10	7	15	2	0	7	9	3	4	0
C016	3	2	8	4	2	1	1	2	4	1	0	0
C017	2	4	4	5	9	0	0	0	5	1	3	0
C018	0	1	7	2	3	0	2	0	15	3	1	1
C019	1	1	2	1	2	0	0	0	1	0	1	0

Table XI

Competency Factor - Task Factor Pairings

Task Factors	Competency Factors
1	1, 7[a]
2	2, 4, 5
3	2, 5, 6[a]
4	2
5	1, 3
6	3
7	2, 5
8	3
9	5
10	
11	5, 6
12	4

[a]This competency factor is one of two identified by the second stage of the identification process described in the section on data analysis procedures.

Task factor 1. Designing research studies and conducting and interpreting data analyses. The competency factors related to this task factor are No.1, data collection, processing, analysis, and presentation competencies and No.7, statistical competencies. A review of the competencies that make up these two competency factors indicates that persons involved in this function (task factor) use skills of data processing, data analysis, information presentation and instrument construction, and knowledge of statistics, experimental controls and computer capabilities.

Task factor 2. Developing instructional materials. The competency factors related to this task factor are No. 2, evaluation competencies; No. 4, knowledge of students, teachers, and educational and psychological processes; and No. 5, operational administrative skills. A review of the competencies which form these three competency factors shows that the competencies are logically related to the function of developing instructional materials. Evaluation skills are obviously relevant to the field and product testing aspects of development. Knowledge about students, teachers, learning theories, and educational processes is obviously necessary to the person developing instructional materials. Skills in administering a project and supervising work of other persons are also relevant since development seems typically to be a team activity requiring coordinated efforts of many persons.

Task factor 3. "First-level" administration of inquiry and inquiry-related projects and activities. Competency factors No. 2, evaluation competencies; No. 5, operational administrative skills; and No. 6, policy making and decision making competencies are related to this task factor. Study of these competency factors shows the inclusion of the obviously relevant clusters of administrative competencies such as budgeting, personnel supervision, specification of work tasks and procedures, resource allocation, personnel hiring and evaluation, and management planning systems such as PERT. It is not surprising that evaluation competencies are included in view of their contribution to administration through providing information to support decision making.

Task factor 4. Conducting evaluations and constructing and using data collection instruments. Competency factor No. 2, evaluation competencies, is related to this function, which would be expected in view of the similar nature of the competency and task variables. Included in this competency factor are competencies such as planning evaluations, specifying objectives, constructing attitude scales, putting numerical information in written form, and knowledge of evaluation and measurement.

Task factor 5. Diffusing information and products. Competency factors No. 1, data collection, processing, analysis, and presentation competencies, and No. 3, ability to obtain and use information to forecast events or outcomes or develop new ideas are related to this task factor. The latter competency factor emphasizes dissemination skills such as using library search processes, writing clearly and concisely, and summarizing and synthesizing ideas. The most relevant skills on the first competency factor are presentation competencies, such as presentation of data, describing or elaborating in writing, and putting numerical information into verbal form.

Task factor 6. Developing and operating information storage and retrieval systems. Competency factor No. 3, ability to obtain and use information to forecast events or outcomes or develop new ideas, is related to this task factor. This competency factor includes library search skills, the ability to critique written presentations, the ability to summarize and synthesize, knowledge of and ability to use information retrieval systems, and the ability to write clearly and concisely. All these competencies are clearly relevant.

Task factor 7. Evaluating inquiry and inquiry-related proposals and monitoring funded projects. Two competency factors related to this task factor are No. 2, evaluation competencies, and No. 5, operational administrative skills. Many evaluation competencies obviously come into play in evaluating proposals. Administrative competencies useful in monitoring funded projects include ability to make progress assessments for ongoing activities, knowledge of legalities related to project management, and knowledge and ability to use management systems such as PERT.

Task factor 8. Searching, reading, and reviewing the literature. Competency factor No. 3, ability to obtain and use information to forecast events or outcomes or develop new ideas, is related to this task factor. Several competencies on competency factor 3 which are logically related to the process of obtaining information from the literature include the following: ability to use library research techniques, ability to critique written presentations, ability to summarize or synthesize, and ability to use information retrieval systems.

Task factor 9. Designing and maintaining computer systems and writing computer programs. Competency factor No. 5, operational administrative skills, is related to this task factor. Skills in budgeting, personnel supervision, work task and procedures specification, resource allocation, writing, and knowledge of proposal preparation are included on competency factor 5. It is not unexpected that these administrative skills are employed in designing computer systems.

Task factor 10. Unnamed. Because tasks within this factor did not appear logically connected in any way, no attempt was made to place competency factors with task factor 10.

Task factor 11. "Second-level" administration of inquiry and inquiry-related projects and activities. Competency factors related to this function are No. 5, operational administrative skills, and No. 6, policy making and decision making competencies. Both the task factor and the two competency factors are clearly focused upon administration. Among the administrative competencies listed under these factors are skill in project budgeting; personnel supervision; specification of work tasks and procedures; resource allocation; recruiting, hiring and evaluating personnel; making progress assessment of ongoing activities; ability to make long-range forecasts; knowledge of project or program management; knowledge of role of inquiry and inquiry-related activities in education; and knowledge of management and planning systems such as PERT.

Task factor 12. Developing and scoring tests. Competency factor No. 4, knowledge of students, teachers, and educational and psychological processes, is related to this task factor. Knowledge of learning theories and developmental psychology, knowledge of teacher roles, knowledge of instructional approaches, knowledge of theory and techniques for assessing student achievement, and ability to obtain cooperation of students in testing situations are obviously competencies which are relevant to this task factor.

Relationships Between RDDE and Inquiry and Inquiry-related Functions Identified Through These Data

The basic objective of this study was to identify the functions, tasks and competencies required in exemplary educational research and research-related activities. The results of the data analysis reported in previous sections of this paper have identified clearly tasks and competencies

required in such activities. The eleven interpretable task factors also identify eleven broad functions (groups of tasks) which are performed by inquiry and inquiry-related personnel in the field of education. A discussion of these functions and their relationship to the commonly used rubrics of research, development, diffusion, and evaluation is contained in this section.

A "function" was defined for this study (see Technical Paper No. 18) as a "broad range of activities or tasks which taken together lead to the attainment of a particular inquiry goal." Examples of functions were listed as research, development, diffusion, and evaluation (RDDE)--four activities which, on a priori grounds, have been thought of as collectively comprising the spectrum of inquiry and inquiry-related activities in education. It was the intent in this study to ignore the RDDE rubrics and let the data analysis suggest functions which could be defended on empirical grounds. However, it was also the intent to try to relate functions identified through the data analysis with the more commonly used categories of RDDE. The attempt to draw such relationships appears below, in Table XII.

Table XII

Interpretation of Relationships Between Task Factors and Research, Development, Diffusion, and Evaluation

	Task Factor	Is thought to be related to Research (R), Development (De), Diffusion (Di), or Evaluation (E)
1	Designing research studies and conducting and interpreting data analyses	R (E)
2	Developing instructional materials	De
3	"First-level" administration of inquiry and inquiry-related projects and activities	
4	Conducting evaluations and constructing and using data collection instruments	E (R)
5	Diffusing information and products	Di
6	Developing and operating information storage and retrieval systems	(Di)
7	Evaluating inquiry and inquiry-related proposals and monitoring funded projects	(E)
8	Searching, reading, and reviewing the literature	(R)
9	Designing and maintaining computer systems and writing computer programs	
10	Unnamed	
11	"Second-level" administration of inquiry and inquiry-related projects and activities	
12	Developing and scoring tests	

NOTE: Parenthetical entries in the column at the right denote secondary emphasis.

The relationships between the categories of RDDE and the 12 functions (task factors) presented in Table XII are viewed as tentative; the relationships are not data-based but rely instead on logical interrelationships which seem defensible. Others may find compelling arguments for proposing different interrelationships. Such efforts seem appropriate since the intent here is to suggest probable relationships rather than arguing that all defensible relationships have been included. With this proviso, the relationships shown in Table XII are discussed briefly below.

The function of designing research studies and conducting and interpreting data analyses (task factor 1) is clearly a part of research as we have commonly used the term. In addition, evaluation is dependent upon data analysis and interpretation and therefore overlaps part of this function as well. Although data may be analyzed and interpreted as part of a development or diffusion effort, it does not follow that this function is therefore development or diffusion. In development, data analysis and interpretation would normally occur only during product testing or field testing activities, which are clearly evaluation by another name. In diffusion, data analysis and interpretation might take place in activities such as market analysis; however, this is simply research, used in this instance to provide information for use by diffusers.[14]

---

[14] RDDE can each be applied to one another. For example, one can do research on diffusion, development, or evaluation processes. One can evaluate research, development, or diffusion efforts. Results of research, evaluation, and development can all be diffused. Instructional materials can be developed to teach research, evaluation, or diffusion. However, such interrelationships seem to the authors to be conceptually sterile and are not included in the emphases shown in Table XII.

The function of developing instructional materials (task factor 2) obviously includes most of what has been referred to as development in the commonly used rubric of RDDE and requires little comment here. The fact that other development efforts (e.g., the development of organizational or staffing plans) is not included is probably a simple reflection of the fact that development of instructional materials currently occupies most of the attention of the relatively small cadre of educational developers.

The administrative functions (task factors 3 and 11) cut across all four categories of RDDE; administration at both levels is required in projects or programs of all four types. However, administering a research project is not viewed here as research per se, but as a function which facilitates research; parallel reasoning applies to the administration of DDE activities. Therefore, administration is viewed here as an activity that is neither RDD nor E but is requisite for successful accomplishment of any such activities.

The function of conducting evaluations and using data collection instruments (task factor 4) is clearly the E of RDDE. In addition, data collection instruments are essential in research activities and research is therefore viewed as overlapping partially with this function. As with task factor 1, this function may be useful in development or diffusion efforts, but only to the extent that evaluation or research is a necessary part of such efforts.

Diffusing information and products (task factor 5) is clearly the same function that has been described in the literature as diffusion. It should be noted, however, that the activities which comprise this function are for the most part dissemination activities and do not include other

activities such as demonstration or adoption which are typically viewed as part of the diffusion process (e.g., discussions of diffusion by Clark and Guba[15]). It may be that diffusion does include such activities and the data analyzed here are inaccurate because the agencies and individuals interviewed are not engaged in the full range of diffusion activities which would have been found had other agencies or individuals been selected. Conversely, it may be that the data reflect reality and activities such as demonstration and adoption are important and viable only in the minds of adademicians and not in the real world of diffusion. The data presented herein do not allow resolution of this question.

Developing and operating information storage and retrieval systems (task factor 6) is viewed as one type of diffusion. It is clearly not research, evaluation, or development, although it may be useful in any of these activities. The necessary activity of searching out information for input into such systems may be a type of research; however, such activities are subsumed under task factor 8, searching, reading, and reviewing the literature. This function (task factor 8) may also be useful in development, diffusion, or evaluation, but it seems reasonable to interpret it as a type of research function used in these activities rather than DD or E per se.

Although there is an element of evaluation in task factor 7, evaluating inquiry and inquiry-related proposals and monitoring funded projects, this should not obscure the fact that this is largely a function of personnel in

---

[15]Clark, D. L. and Guba, E. G. An examination of potential change roles in education. Paper presented at a Seminar on Innovation in Planning School Curricula at Aerliehouse, Virginia, Oct.2 - 4, 1965.

funding agencies or persons temporarily helping funding agencies reach evaluative judgments and is not a routine function of the professional evaluator.

Designing and maintaining computer systems and writing computer programs (task factor 9) seems a function related to but independent of RDDE. It is used most frequently in R and E but is not in and of itself research or evaluation, even though it serves as a tool in both. The same logic applies to task factor 12, developing and scoring tests. This function is critical to much research and evaluation in that tests are among the most common data collection instruments; however, this does not make measurement research or evaluation.

The attempts to relate the 12 functions (task factors) to RDDE should not be interpreted as meaning that RDDE are viewed as preferable (or even valid) categories of inquiry and inquiry-related activities. The 11 interpretable task factors are proposed here as more meaningful categories for use by persons concerned with training inquiry and inquiry-related personnel. The attempt to relate these functions to RDDE is merely an attempt to assist persons who are more familiar with that rubric to interpret or use the results of this study.

Summary

Data obtained in interviews with persons engaged in exemplary educational research and research-related work (see Technical Paper No. 18) were categorized into 69 task categories and 226 categories of competencies employed in performing these tasks. Inter-judge reliabilities of transfer of interview data to written records and categorization of these data were computed. Factor analysis was used to isolate 12 task factors or functions. Factor analysis and additional empirical-logical procedures were used to identify seven competency factors. Relationships between task factors and competency factors were identified. Interpretations of these factors and relationships between the task factors and the commonly used categories of RDDE are discussed.

It is recommended that the functions, tasks, competencies and their interrelationships identified in this study be viewed as tentative and in need of validation. Limitations, such as the size of the sample (116), when viewed in the light of the wide range of tasks and competencies identified, must be considered. Should further validations be conducted, the pilot work reported herein should provide a basis for the development of data collection procedures that can be focused on precise functions, tasks and competencies and thus collect more data about each than was possible in this attempt to depict the domain.

References

Anderson, R. D., Worthen, B. R., & Soptick, J. M. Development of an interview procedure for ascertaining tasks and competencies required of personnel conducting exemplary research and research-related activities in education. Technical Paper No. 18. Boulder, Colo.: AERA Task Force on Research Training, 1971.

Campbell, D. T., & Stanley, J. C. Experimental and quasi-experimental designs for research on teaching. In N. L. Gage (Ed.), Handbook of research on teaching. Chicago: Rand McNally, 1963. (Reprinted as Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1966.)

Cattell, R. B. (Ed.) Handbook of multivariate experimental psychology. Chicago: Rand McNally, 1966.

Clark, D. L., & Guba, E. G. An examination of potential change roles in education. Paper presented at a Seminar on Innovation in Planning School Curricula at Aerliehouse, Virginia, October 2-4, 1965.

Dixon, W. J. (Ed.) BMD biomedical computer programs. Berkeley and Los Angeles: University of California Press, 1968.

Winer, B. J. Statistical principles in experimental design. New York: McGraw-Hill, 1962.